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Dietary Patterns and Their Socioeconomic and Behavioral Determinants in 6- to 8-Year-Old Portuguese Children

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ABSTRACT

Adherence to a healthier diet is declining, with children consuming more saturated fats and simple carbohydrates. Factors influencing this choice were studied using a cross-sectional study with children (6 to 8 years old) living in Coimbra. Socioeconomic and behavioral factors were obtained from the parents. Dietary patterns of 1,063 children were identified: Mediterranean (MedDiet), saturated fats (SFatDiet), and base of Portuguese diet (BPDiet). Their relationship with socioeconomic and behavioral determinants was analyzed. SES determined strongly the dietary choices with lower SES being associated with higher consumption of SFatDiet and higher SES with BPDiet. Worse diet quality was shown to coexist with other unhealthy behaviors.

KEYWORDS

children; dietary habits; Mediterranean diet; parenting; saturated fatty acids; SES

For children, healthy diet has important short- and long-term health effects (Kaikkonen, Mikkilä, and Raitakari 2014; Koletzko et al. 2012). Studies of dietary behaviors employ a multidimensional approach because they involve a variety of individual choices starting from the selection of the food to the conditions that surround each meal. Human choices are shaped by individual, societal, and cultural factors. When it comes to children's diet, the home environment is a huge contributor to the adoption of healthy or unhealthy behaviors by mediating access to unhealthy foods, the availability of fruits and vegetables, and parental role modeling and attitudes (Østbye et al. 2013; Pearson, Ball, and Crawford 2012; Ranjit et al. 2015; Rodenburg et al. 2012).

A home environment is a complex social system involving a number of factors. Observations on childhood nutrition related to a westernized lifestyle, adopted widely by high- and middle-income countries, point to an increase in consumption of foods prepared away from home, an increase in the total calorie intake and intake from snacks, and an increase in the consumption of fried and nutrient-poor foods (Chan and Sobal 2011;

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Gidding et al. 2006; Lachat et al. 2012; Popkin, Adair, and Wen 2012; Ranjit et al. 2015). High-fat foods are typically very palatable and less satiating, which leads to overconsumption (Drewnowski and Almiron-Roig 2010). At the same time, a general decline in fruit and vegetable consumption—other than fried potatoes—has been observed (Hall et al. 2009).

The Mediterranean diet is a traditional food pattern present in the areas of the Mediterranean basin, Portugal included. The primary components of this diet include an abundance of vegetables, fruits, and olive oil and a moderate intake of fish and meat, little consumption of sugars, and a low amount of animal and trans fats (Widmer et al. 2015). Although studies have revealed the highly beneficial health effects of the Mediterranean diet, recent research suggests that people are abandoning this diet and associated healthy lifestyles —with higher daily ready-made meal consumption or eating away from home—and replacing it with unhealthy food patterns (Bonaccio et al. 2012; Martínez-Gonzalez et al. 2011; Sanchez-Benito, Sanchez-Soriano, and Ginart Suarez 2009; Trichopoulou, Bamia, and Trichopoulos 2009; Trichopoulou and Lagiou 1997). There seems to be a recent tendency toward the replacement of traditional cuisine with highly processed foods, animal fat, and fast foods (Farajian et al. 2011; San Juan 2006; Serra-Majem et al. 2004). The current economic crisis can be responsible for reinforcing this change of behavior since the Mediterranean food pattern is usually more expensive and harder to cook (Rodrigues et al. 2008). Recent studies have shown that food insecurity in Portugal is highly prevalent, affecting mainly homes with low income and low education (Álvares and Amaral 2014).

Unhealthy behaviors tend to cluster and create an accumulated risk (Fernández-Alvira, De Bourdeaudhuij, and Singh 2013). A more complete and multivariate understanding of what may influence children's dietary behavior is needed. The aim of this study is to describe differences in dietary habits among Portuguese children, especially the adherence to a specific dietary pattern in association with a number of demographic, socioeconomic, and behavioral characteristics. This is especially relevant within the context of the economic crisis affecting many European countries, including Portugal.

Materials and Methods

A cross-sectional study was done among 6- to 8-year-old children attending elementary schools in the Coimbra district of Portugal from September 2011 to June 2012. Children from public and private schools, located in urban, suburban, and rural areas of the district, were invited to participate in the study. Apart from the geographical location within the district, no preselection criteria were applied. A total of 1,777 questionnaires were distributed among 28 public schools belonging to 7 school clusters and 4

private schools. Questionnaires about environmental and family factors were distributed among the parents/legal guardians of children from the first and second grades of primary school. Only children with signed authorization were involved further in the process. The data for this study were collected under the project "The association of childhood obesity with asthma and rhinitis symptoms in 6–8-year-old children living in the Coimbra district, Portugal: the role of environmental, family and socioeconomic factors." Environmental and family factors were verified using the ISAAC (The International Study of Asthma and Allergies in Childhood) environmental questionnaire for 6- to 7-year-old children. The questionnaire is a tool designed by the ISAAC study that has been validated in many countries (including Portugal) and previously used to study food patterns in children this age (Ellwood et al. 2001; Nagel et al. 2010). In addition, it was approved by *Direcção Geral de Inovação e Desenvolvimento Curricular* (DGIDC).

A food frequency questionnaire was administered, and the foods included in the ISAAC survey were meat, fish, potatoes, pasta, rice, legumes, fruits, butter, margarine, eggs, milk, cereals (including bread), dried fruits, and fast food. The parents/legal guardians of the child had to choose between three options when describing the number of times per week that the child ate each food type: never or occasionally, once or twice per week, or three or more times per week. We then performed a frequency analysis of the consumption of each food.

Further, we wanted to study the dietary patterns in our population. In order to do that, factorial analysis of diet was applied running the principal components analysis (PCA). Both the Kaiser-Meyer-Olkin index (0.633) and Bartlett's test ($p < .01$) indicated that the correlation between the variables was sufficiently strong for a factorial analysis. The Bartlett test of sphericity and the Kaiser–Meyer–Olkin measure of sampling adequacy were used to assess whether the data were suitable for factor analysis. Cereals, milk, and margarine were excluded as they did not cluster well in the model (Cronbach's alpha measure of internal consistency). Retention of factors was based on the scree test (Cattel 1966). Food items were retained in the pattern if the factor loading value was equal to or above 0.30, and the least acceptable communality (the proportion of variance of each variable that could be explained by the factors) was 0.25 (Basilevsky 1994). The varimax rotation was chosen with Kaiser normalization, and three components were predefined.

The clustering of the elements in a three-dimensional matrix and the exact values of scores for each element within the three components are presented in table 1.

The Bartlett method was applied to generate the scores for the three components, and continuous variables were used to determine the degree

Table 1. Rotated Factorial Matrix, Factor Loads, and Communalities (h_2) Estimated for the Three Dietary Patterns Identified among Children, Coimbra, Portugal, 2011–2012 (n = 1,063).

	Patterns			
Food group	Base of Portuguese diet	Mediterranean diet	Saturated fats	h_2
Rice	0.79			0.63
Pasta	0.69			0.53
Meat	0.54			0.37
Potatoes	0.51			0.36
Vegetables		0.78		0.59
Legumes		0.59		0.42
Fruits		0.58		0.34
Fish		0.47		0.43
Fast food			0.67	0.46
Eggs			0.66	0.48
Butter			0.27	0.20
Eigenvalues	2.04	1.55	1.23	
% of explained variance	18.53	14.07	11.20	
% of accumulated explained variance	18.53	32.60	43.80	

of adherence to each dietary pattern (the higher the score, the higher the adherence). One variable for each component was created, describing the representation of each type of diet in the nutritional habits of each child.

To evaluate the level of sedentary behavior, we asked parents/legal guardians two questions regarding their children's habits: (1) how many times per week the child practiced vigorous physical activity (PA) (by vigorous, we refereed to activities that would leave the child breathing heavily) and (2) how many hours per day, on an average week, the child watched television (TV).

Information about the current smoking habits of the mother, as well as the presence of any other smokers in each household, was obtained.

The postal code of the child's residence was obtained. From this, we determined the residence parish (*freguesia*). The degree of urbanization was assessed using the new Urban Areas Typology released by the National Statistics Institute in 2009 (Instituto Nacional de Estatística [INE] 2009). Three types were listed: urban, suburban, and rural.

The survey contained questions about the socioeconomic situation of the child's family, such as the level of parental education and the occupation.

To create an indicator of the family's socioeconomic status, we used the maternal and paternal level of education and their occupation, information we obtained through the questionnaire. The level of education was categorized according to the levels of the Portuguese educational system: basic education (4 years), basic education (6 years), secondary education (9 years), secondary education (12 years), and higher education (at least a bachelor's degree).

The occupations of the mother and father were determined by using an open question, and the professions were further classified into a 10-point

scale of large groups taken from the Portuguese Classification of Professions from 2010 (Instituto do Emprego e Formação Profissional [IEFP] 2010).

Because of high correlation among the maternal and paternal levels of education and their occupations, a principal component analysis (PCA) was performed through exploratory factor analysis (EFA) to obtain a construct (i.e., factor or latent variable) for the global socioeconomic status (SES). The EFA aims to identify the latent structure of a group of interrelated variables from the understanding that if the variables are correlated, then they are correlated because the association results from a common but not directly observable characteristic (Chavance et al. 2010; Marôco 2010). Thus, the principal component analysis developed using these indicators revealed a construct representing 68.9% of the shared variance, with Cronbach's α index equal to .89.

A question about the number of siblings of the child was included separately as it did not cluster with the other SES elements (Cronbach's alpha measure of internal consistency).

First, univariate analysis of the linear regressions was performed in order to study the association between each dietary pattern and gender, age, SES, number of siblings, urbanization of the residential area, TV watching, and the PA level in children. The factors that were significantly associated with the diet pattern were included in the multivariate model, adjusting these factors for each other and testing, therefore, which of the socioeconomic and environmental variables is associated with dietary intake, independently of other covariates. Results were presented as unstandardized B coefficient, and a p value of $< .05$ was considered significant.

Results

The response rate was 59.8% with 1,063 questionnaires returned. There was no significant difference in response rate between private and public schools ($p = .88$) or among urban, suburban, and rural areas ($p = .42$). Our sample consisted of 531 girls (51%) and 510 boys (49%); the mean age was 7.26 years ($SD = 0.61$).

The estimated number of all children in the first and second grades in the Coimbra district is 8,200 (Instituto Nacional de Estatística [INE] 2011). Compared to the census data for the corresponding proportion of the population, per degree of urbanization of the residential area, our sample showed a higher frequency of children from urban areas as compared to the distribution from the census (72% of children living in urban areas in our sample compared to 57% for the district) (Comissão de Coordenacão e Desenvolvimento Regional, & do Centro 2008). To correct for this difference, we applied the poststratification weights correcting for the degree of

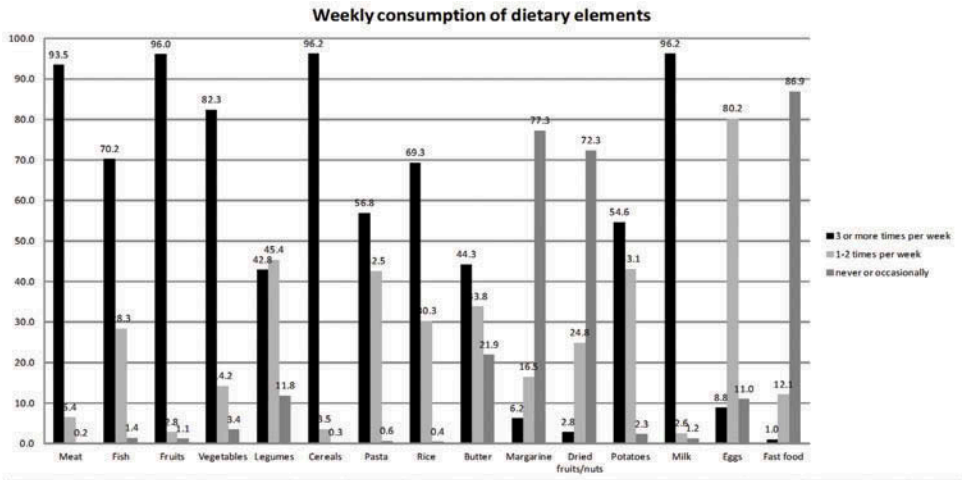
Table 2. Distribution of Children According to Demographic, Socioeconomic, and Behavioral Characteristics, Coimbra, Portugal, 2011–2012 (n = 1,063).

Characteristic	n	%
Gender		
Girls	531	51
Boys	510	49
Number of siblings		
0 (only child)	283	27.3
1	554	53.5
2	149	14.4
3 or more	50	4.8
Maternal education		
Basic (4 years)	30	2.9
Basic (6 years)	65	6.3
Secondary (9 years)	127	12.4
Secondary (12 years)	271	26.4
University	535	52
Paternal education		
Basic (4 years)	39	3.9
Basic (6 years)	100	9.9
Secondary (9 years)	192	19
Secondary (12 years)	281	27.8
University	399	39.5
Residential area (Koletzko et al. 2012)		
Urban	687	72.2
Suburban	190	20
Rural	74	7.8
Vigorous physical activity		
Never or occasionally	143	14
1–2 times per week	611	59.7
3 or more times per week	269	26.3
TV hours/day		
≥ 5	69	6.7
3–5	136	13.2
1–3	548	53.2
< 1	277	26.9
Current maternal smoking		
No	830	81.1
Yes	194	18.9
Anyone smoking at home		
Yes	366	35.8
No	656	64.2

Source: (Definitions) (Koletzko et al. 2012), based on the INE classification (INE 2009).

urbanization of the residential area. Table 2 shows sociodemographic characteristics of the sample.

In figure 1, children's weekly intake of each food item is reported. Later, these foods were clustered, creating dietary patterns. Dietary elements consumed most frequently (three or more times per week) were milk (96.2%), cereals (96.2%), fruits (96.0%), and meat (93.5%). Eggs (80.2%), potatoes (43.1%), and pasta (42.5%) were consumed, on average, one or two times per week. Margarine (77.3%), dried fruits (72.3%), and fast food (86.9%) were stated to be consumed never or occasionally by most children.



Dietary element (n)	Meat	Fish	Fruits	Vegetables	Legumes	Cereals	Pasta	Rice	Butter	Margarine	Dried fruits/nuts	Potatoes	Milk	Eggs	Fast food
3 or more times per week	962	723	988	847	441	991	585	713	452	63	29	558	984	90	10
1-2 times per week	66	292	29	146	467	36	438	312	345	166	252	440	27	819	124
never or occasionally	2	15	12	35	121	3	6	4	224	777	735	24	12	112	886

Figure 1. Frequency of the consumption of dietary elements among studied children. Results presented as percentage of children in each frequency group; *n* values are presented in table 1.

Both the Kaiser–Meyer–Olkin index (0.633) and Bartlett's test ($p < .01$) indicated that the correlation between the variables was sufficiently strong for a factorial analysis. Scree test results allowed for the identification of three dietary patterns: base of the Portuguese diet (BPDiet), with eigenvalue 2.04; Mediterranean diet (MEDiet), with eigenvalue 1.55; and saturated fat diet (SFATDiet), with eigenvalue 1.23. The BPDiet pattern (loading heavily on meat, pasta, potatoes, and rice) explained 18.53% of the data variation. The MedDiet pattern (consisting of fruits, vegetables, legumes, and fish) explained 14.1% of the data variation. The SFatDiet pattern (consisting of fast food, butter, and eggs) explained 11.2% of the total variation. Together, the three patterns explained 43.8% of the dietary intake variance (table 2).

To study the association of the covariates (gender, age, PA, TV watching, SES, number of siblings, residential area, current maternal smoking, and smoking at home) with the three dietary pattern scores obtained from the PCA (table 3), we used linear regression. We chose this test due to the continuous character of the dietary scores and mixed types (continuous and categorical) of the covariates included in the model. Results were significant for the association of BPDiet with gender ($p = .04$, B = 0.13) and SES ($p < .01$, B = 0.016); MEDiet with SES ($p = .01$, B = 0.09); and SFATDiet with TV viewing ($p < .01$, B = 0.12), number of siblings ($p = .01$, B = 0.10), PA ($p = .02$, B = −0.12), and SES ($p < .01$, B = −0.17).

In the final model, we included all the covariates significantly associated with dietary patterns in the univariate test. In this model, children's gender ($p = .047$, B = 0.13) and SES ($p < .01$, B = 0.16) remained

Table 3. Factors Associated with Dietary Pattern Scores in Children.

	Univariate (crude)			Multivariate (adjusted)		
Variable	B	95% CI	*p* value	B	95% CI	*p* value
			Base of Portuguese diet			
Gender	0.13	0.01–0.25	0.04*	0.13	0.00–0.25	0.047*
Age	−0.04	−0.14 to 0.07	0.49			
Physical activity	0.09	−0.01 to 0.19	0.07			
TV watching	0.01	−0.06 to 0.09	0.74			
SES	0.16	0.10–0.22	≤ 0.01*	0.16	0.10–0.16	< 0.01*
Number of siblings	0.06	−0.02 to 0.13	0.17			
Residential area	−0.03	−0.16 to 0.09	0.60			
Current maternal smoking	−0.08	−0.18 to 0.03	0.15			
Smoking at home	0.01	−0.15 to 0.17	0.88			
			Mediterranean diet			
Gender	0.01	−0.11 to 0.14	0.85	NA		
Age	0.10	0.00–0.20	0.06			
Physical Activity	0.09	0.00–0.21	0.08			
TV watching	−0.06	0.00–0.22	0.12			
SES	0.09	0.00–0.23	0.01*			
Number of siblings	−0.04	0.00–0.24	0.28			
Residential area	0.03	0.00–0.25	0.57			
Current maternal smoking	−0.01	0.00–0.26	0.86			
Smoking at home	−0.05	0.00–0.27	0.48			
			Saturated fat diet			
Gender	−0.04	−0.16 to 0.09	0.56			
Age	0.10	0.00–0.20	0.06			
Physical Activity	−0.12	−0.22 to 0.02	0.02*	−0.06	−0.16 to 0.04	0.26
TV watching	0.12	0.05–0.20	≤ 0.01*	0.11	0.03–0.18	0.01*
SES	−0.17	−0.23 to 0.11	≤ 0.01*	−0.15	−0.21 to 0.08	≤ 0.01*
Number of siblings	0.10	0.02–0.18	0.01*	0.09	0.01–0.17	0.03*
Residential area	−0.02	−0.13 to 0.08	0.67			
Current maternal smoking	0.08	−0.08 to 0.24	0.31			
Smoking at home	0.09	−0.04 to 0.22	0.16			

Note. SES = socioeconomic status; CI = confidence interval; TV = television. Results obtained using multiple linear regression, presented as B = unstandarized coefficient.
*Significant at $p < .05$.

significantly associated with increased BPDiet; TV viewing ($p = .01$, B = 0.11) and number of siblings ($p = .03$, B = 0.09) were associated with increased SFATDiet; and SES ($p < .01$, B = −0.15) was associated with decreased SFATDiet adherence.

Discussion

Clustering of unhealthy behaviors is a dangerous phenomenon and has been observed worldwide. In our study, the adoption of healthy or unhealthy habits is determined at more than one level with less physical activity and more time spent watching TV being associated with higher intake of saturated fats by children.

Results of studies worldwide suggest that people from lower SES backgrounds consume more energy-dense and nutrient-poor diets, which are

usually less expensive (Aggarwal et al. 2011; Coon et al. 2001; Moreira et al. 2010; Shahar, Shai, and Vardi et al. 2005). Indeed, we showed that children from higher-SES families consume more higher-quality foods, such as the Mediterranean diet, compared to children from lower SES families. More important, we revealed that the lower SES is the strongest predictor of an unhealthy diet, independent of all the studied covariates. A national census reported that Portuguese families are spending less money on food and leisure and that those expenses have been declining during the last years (Instituto Nacional de Estatística [INE] 2011). This is worrying because food-insecure households have been correlated with less money to spend and being forced to buy cheaper food and consuming less fruit, vegetables, and daily products (Mark et al. 2012; Monsivais and Drewnowski 2007; Sancho 2011). Portuguese children are indeed consuming unhealthier foods, and this is especially true in boys from lower SES families.

We also found a correlation between sedentary behaviors and unhealthy diets, which is in line with other findings suggesting that watching TV during meals is associated with a higher consumption of pizza, salty snacks, and soda, which itself is related to family income, making children from lower-SES families more vulnerable to these obesity-related behaviors (Bibiloni et al. 2011, 2012; Darmon and Drewnowski 2008; Leech, McNaughton, and Timperio 2014a, 2014b, 2015; Lopez et al. 2009; Salmon, Campbell, and Crawford 2006).

In difficult economic situations, additional siblings may decrease the availability of food for each child and can be related to the adoption of a nutrient-poor diet. Our findings suggest that a large number of siblings affects the quality of a child's diet, which might be due to the bigger general economic investment from parents, leading them to choose cheaper foods (Smithers, Brazionis, and Golley 2012).

Boys in our study seemed to adhere more to a diet based on starchy foods and meat. This is in line with the results obtained by Moreira et al. studying Portuguese children who demonstrated that girls consumed significantly lower amounts of meat and higher amounts of vegetables while boys exhibited significantly higher consumption of dietary fiber, fast food, and carbohydrates (Moreira et al. 2010). It is common that girls choose diets characterized by a higher intake of vegetables, fruits, and fish, while meat (especially red meat) and large portion sizes are related with being a boy (Arganini et al. 2012). Other researchers also agreed that the Mediterranean diet is more often followed by girls, in particular the ones with higher parental SES (Bibiloni et al. 2012). These results show a disparity between genders in healthy food consumption. Indeed, it has been shown that parents are more concerned about a child's obesity if the child is a girl (Moore, Harris, and Bradlyn 2012). This points to the need for a gender-specific approach when addressing nutritional issues in pediatric populations.

Our study has important strengths. First, we used a combination of socioeconomic and environmental factors, in concert with the dietary patterns of the children. Multivariate analysis gave us the opportunity to study the effects of multiple variables and to recognize the most potent predictors of consumption. Our sample is representative of the population of children from central Portugal. Sufficient sample size and sociodemographic distribution, and application of poststratification weights to account for the slight overrepresentation of urban children, improved the applicability of the study and the generalizability of the results. With regard to limitations, our results are based on cross-sectional observations; thus, cause–effect relationships cannot be established, and only hypotheses can be generated. Eating patterns and behaviors were self-reported, which can introduce some bias. In addition, data relating to some important foods such as olive oil, which is commonly studied in research of Mediterranean diets, is lacking, as the questionnaire was predesigned by ISAAC.

The weather conditions in Portugal vary according to the season of the year and the geographical region. However, most of the year Portugal does not have extreme weather conditions, which can enable outdoor activities such as PA.

Summarizing, we found that the children's eating patterns are influenced by sociodemographic and lifestyle factors. Family socioeconomic status appears to be the strongest predictor of food choices. Worse diet quality was shown to coexist with other unhealthy behaviors such as more hours of watching TV and lower levels of physical activity, which added to the evidence that children with poorer diets have more probability of adopting other unhealthy lifestyle elements. These findings highlight the important modeling role that the family has when it comes to children's eating behavior, and as such, efforts to raise parental awareness should be made. Tailor-made, family-focused interventions are necessary to target the variety of factors involved in unhealthy habits, especially in the face of the crisis affecting not only Portugal but also many parts of the world.

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